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A multimedia tutorial shell with qualitative assessment in biology

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Key Words:

Generic shell, multimedia, qualitative assessment, independent learner, navigation

Outline:

The project is developing methods to produce multimedia tutorials relatively quickly and cheaply, using a generic software shell suitable for any subject area. The shell is a version of one produced originally as part of the HEFC-funded TLTP initiative by the Biodiversity Consortium. Tutorials presented in the shell will provide the student with a structured learning experience that will allow their initial knowledge level or their knowledge acquisition and progress to be qualitatively and quantitatively assessed. Where areas of weakness are revealed by the assessment, students will be advised to study particular parts of the tutorial in order to improve their understanding.

Context:

We are developing the shell in the context of a project to produce *The Human Brain* CD-ROM, a multimedia tutorial on the human nervous system, for the Open University course SD206 *Biology: Brain and Behaviour*. This level 2, 60-point course attracts about 800–1000 students each year, about half taking a science and half a psychology degree. *The Human Brain* is intended to address the problems distance learners have in understanding the nervous system, in particular the complex three-dimensional anatomy of the brain. A prototype of the shell, containing a single introductory section of *The Human Brain* (the ‘Overview’), was sent to students taking the SD206 course in 1997. A more advanced version, though still without the Concept Test assessment component (see below), containing seven sections of *The Human Brain*, is being sent to 1998 students. The final version of the shell will be ready later in 1998, and the final version of *The Human Brain*, which is expected to have 10-12 sections, will be completed in 1999. At present, *The Human Brain* is optional material for students, since they are not expected to have a PC to complete the course. From 1998, however, all students entering our level 1 science course are obliged to use a PC, so it may be decided to make the CD-ROM compulsory in 1999. The shell developed for *The Human Brain* is now being used to develop a number of other biology tutorials for various other courses, but the aim from the beginning has been to produce a generic shell that can be used for any subject matter.

Description:

Our tutorial shell is based on the ‘Scholar’s Desktop’, produced by the Biodiversity Consortium (Davies, 1995) as part of the HEFC-funded TLTP initiative. We have modified it to include a qualitative assessment component (see below) and to provide a more defined tutorial structure that acts as an aid to navigation. We see the ability to navigate easily through the materials as a

vital feature of a multimedia tutorial. If students are to meet defined learning objectives, it is important that they study all the relevant materials and do not simply wander around in a sea of information. One of the problems associated with some 'encyclopedia'-style CD-ROMs is that they make it difficult for students to go through the materials they need to study in a systematic way; they can easily get lost in a succession of hypertext links and find themselves unable to get back to where they were. On the other hand, a highly structured tutorial with materials presented in a relatively linear fashion tends to be very restrictive and does not provide the student with any freedom to study the materials in the order they choose.

We have resolved this conflict in our version of the shell by combining the best features of linear and explorative learning packages. The student is guided through the available information yet allowed some flexibility to explore within part of the system. Tutorials are based on a three-layered structure in which the amount of detail increases down the levels. The main route through the materials is at Level 1, there are only a limited number of side paths down to Levels 2 and 3, and students are forced to return to Level 1 before moving on. This gives a structure to the tutorial but lets students to explore additional, more detailed, materials if they wish. The levels are represented on screen as a 'cascade' of windows, so students need never lose sight of where they have come from and can easily get back to the main route — the chance of them getting lost in a series of hypertext links is minimized.

The software shell is generic in the sense that it simply provides the functionality required to present multimedia materials and link them together. The contents, which can be on any subject, are held as separate files external to the shell. They are put into the shell, and the specific links required between them are set up, using a simple, bespoke, text-based programming language called DeskTop Code. We are in fact developing a number of biological tutorials based on this shell, though so far *The Human Brain* is the most complete and extensive. These tutorials are designed for independent learners either in a distance-teaching situation or taking a course in a conventional institute of higher education.

Both the shell and any tutorials produced in it are very flexible. The style and 'feel' of a tutorial can be varied by e.g, not using all the levels or functions available in the shell, or changing the background, or the colour and shape of buttons. Once a tutorial is produced there are several ways for the developer to update and extend the materials it contains. For example, individual graphics, sound clips or video clips can easily be replaced with an updated version and a 'News' option provides a text file containing extra information, commentaries, etc, which can be added to or updated at any time. Individual assessment questions can also be replaced relatively easily. It would be possible to make some of these updating options available to the teacher using the tutorial, if this were thought desirable.

Resource Implications:

By the time it is completed, a huge amount of resources (in terms both of money and of academic time) will have been put into modifying the Biodiversity shell and producing *The Human Brain* tutorial. But once the shell is completed, the cost of producing new tutorials will be far less. They could be produced relatively cheaply in terms of the time required to write the academic content and code the materials into the shell. The main cost is likely to be in acquiring high-quality graphics: producing them from scratch is expensive and reusing already published images requires the payment of copyright fees.

Student Assessment:

The shell offers two kinds of assessment: Quick Test and Concept Test. Quick Test consists of multiple choice questions, with feedback for incorrect answers. Students are given an accumulated score as they progress through a section and answer more questions. A student is able to call up Quick Test at any time, close it down and open it again, without loss of their accumulated score. If the student leaves a section and later returns to it, the Quick Test scores are retained. Students only get questions on subjects they have already studied in the tutorial but each question is called up randomly from the bank of possible questions.

We are developing the Concept Test component in collaboration with colleagues at the National Centre for Software Technology in Bombay. The two forms of assessment work similarly in terms of the way students access and answer questions and the way questions are linked to particular screens. Concept Test and Quick Test do, however, have major differences. Each section of the tutorial has a number of associated learning objectives, which includes one or more 'concepts'. For example if one of our objectives is 'You must decide what to eat for breakfast', then the concepts might be 'decide', 'eat' and 'breakfast'. In Concept Test, each question is written to test a particular concept, which in turn tests the student's understanding of the related learning objective. When they have finished working through the questions, students are provided with a separate score for each concept, so that they can see where their understanding is poor, and invited to study a remedial tutorial for any concept they feel they are weak on. The remedial tutorial takes the student through the relevant materials again but is tailored precisely so that only screens necessary to understand that particular concept are included. A 'save' option allows users to save and reload score information for both Quick Test and Concept Test between sessions.

As well as standard multiple choice questions, we are planning to incorporate a number of variations into Concept Test, including questions where students are:

- asked to identify an image.
- presented with an image and asked to click on a particular area.
- presented with an image with blank labels, plus a list of labels which can be selected and placed on the image as appropriate.

In future, further question types may be added, e.g. drag and drop exercises in which items can be sorted into categories; questions that require answers to be entered as text, etc.

In our present tutorials, both Quick Test and Concept Test are used by the student entirely for self-assessment. However, since the computer keeps the score and allows the student to save their results, it would be a simple matter for a teacher to collect student scores and use them for formal assessment.

We also intend to add a further option to the software so that Concept Test can also be used as a pre-test to assess the level of student knowledge and understanding *before* they study the tutorial. In this option, the linkage between question set and screens studied will be 'turned off' so that all questions are available immediately. Such a pre-test will allow the tutorial to be used e.g. to bring a group of students coming from a variety of backgrounds to be brought up to the same level before they start a course.

Evaluation:

The Overview was sent out to students taking the course in 1997. Students were asked to complete a questionnaire, whether they used the CD or not. Of the 83 students who returned the questionnaire, three fifths had used the CD. All those who had not used it said that this was simply because they did not have access to a suitable PC. The feedback we got was almost entirely favourable (Kirkwood, 1997):

- Most students (92%) found the three-layered structure fairly or very helpful as a means of guidance through the materials.
- Most students found the CD easy to operate (86%) and enjoyable to use (84%).
- Most students thought it was better learning about the nervous system on CD than in a book (48% said it was better, 34% said it was better for some topics, 10% said it was about the same)
- Students used the CD as an initial tutorial (66%), for revision (36%), and as a reference source (38%).
- Most comments were enthusiastically favourable and many students said they would welcome more CD-ROM materials.

In 1998, a similar questionnaire will be sent to SD206 students with the fuller version of the CD-ROM, when it is hoped the response rate will be greater.

Key Advice:

- Using a shell reduces the academic and programming time needed to develop a multimedia tutorial considerably, but not the resources needed to produce high-quality graphics.
- Producing multimedia tutorials, even with a shell, takes more time and resources than producing single-medium teaching materials.
- A means of navigation that is simple obvious and consistent, and which does not let the student get lost while giving them the opportunity to explore, is important if students are to achieve the learning objectives.
- The system needs to be flexible so that tutorial styles can vary and so that the teacher can adapt it to the needs of their own courses.
- Usability of the system must be assessed by the user not the developer.

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